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GENERAL PRINCIPLES UNDERLYING THE ORGANIZATION OF THE COURSE IN SCIENCE

The chief value of any course of study is that it provides a good point of departure for new attempts to improve the choice of materials and the methods of instruction. It embodies the best that has been accomplished, clarifies the situation, and makes possible further progress. Any tendency to crystallize the methods of working, or to fix the content of subject matter, is to be avoided. Therefore, the course in science which is presented in this year book is looked upon, not as a finished piece of work but as a stepping-stone to better science teaching. It is not a curriculum which has been written by a few in authority with the expectation that teachers will slavishly follow it, but it is the result of a number of years of independent, experimental, and developmental work in all the grades of the school. For this very reason it may be criticized as somewhat incoherent and lacking in logical development from grade to grade, faults which made-to-order curricula usually lack. This criticism is not dismissed as unimportant, for it indicates the direction in which future improvement may be sought and secured all the more easily, by reason of the work which the preparation of this course of study has involved.

The first step in formulating the course in science was to draw up a statement of the general principles which were to control the work. This formulation of principles, after discussion and revision was accepted by all members of the science committee as a tentative basis on which to proceed. When the work was nearly complete, the statement of fundamental principles was again critically examined and further revised in the light of what had been accomplished. The final revision, which follows, has been presented to the faculty as a whole and approved by them.

I.

The science course shall be organized about those problems and activities of the child which call for study, investigation, and experiment in the fields of physical and natural science.

(*a*) The problem basis for organization of the science course does not mean that the logical or formal organization, so prominent in most curricula will be lost to sight, but that the logical organization will be subordinated to the natural or psychological organization, based on activities and needs. It is reasonable to suppose that if the problems are adequate in number and scope, and properly worked out, the need for formal and logical organization will be felt and developed naturally in the course of the work, rather than made the artificial starting-point for it.

(*b*) The problems of the course, as worked out, should make the pupil conscious of fundamental scientific principles, thus preventing scrappiness and making for the proper organization of the science work.

(*c*) While the problem basis for the course insures a content with a direct appeal to the pupil, it does not follow that the full or larger values of the work will be apparent at the outset. The work as it develops should produce a growing appreciation of its larger value.

(*d*) The problems chosen should provide for a certain amount of overlapping, so that information gained in connection with one problem will be used in the solution of others, and the experience gained in one grade utilized in the work of the next.

(*e*) The course, in addition to formulating these problems, should supply needful data, lists of material, sources of information, and directions for their solution.

II.

The science course shall provide abundant opportunity for the pupil to acquire a rich and varied experience through actual contact with real materials. Informational topics and discussion shall give place, whenever possible, to experiments, to the handling of materials, to the working with apparatus, to the acquiring of first-hand experience on which inferences and conclusions may properly be based.

(*a*) Discussion without a proper basis of experience, and inferences based on guess work, lead to a destruction of real interest and tend to establish habits of thought which are intellectually and morally dangerous.

(*b*) Programs must be sufficiently flexible to make possible the widest use of the shops, the laboratories, the garden, and of excursions for experimental and observational work.

(*c*) The care of pets and animals in the graderoom, or on the school grounds provides projects of especial value. This work develops individual and social responsibility and secures a wholesome contact with animal life which would otherwise be absent from the experience of many children.

(*d*) Each grade will require special science apparatus, aquaria, work-benches, sand- and delta-tables, and materials of great variety. Space to store and to use freely·this equipment is indispensable.

III.

The teacher's freedom, individuality, and preferences, shall be given wide range in the matter of developing the problems suggested in the science course, and in finding new and better ones.

(*a*) The science curriculum should be flexible and dynamic, constantly developing and improving, not fixed and static. Towards this end the teachers actually engaged in carrying on the work are best able to detect weaknesses and suggest improvements. These teachers therefore must take an important part in the preparation and framing of any syllabus or course of study in science.

(*b*) It does not follow that teachers should be free to follow mere personal opinion or that they should indulge every whim in modifying the course of study. They should expect to justify every innovation by sound reasons and prove by the results obtained the worth of their ideas.

IV.

Specialized science has little or no place in the curriculum of the elementary school.

(*a*) Elementary biology, botany, physics, chemistry, etc., should not be taught as such, but much material drawn from these several sciences will contribute to the satisfaction of the child's interests and the solution of his problems. The necessary elements from these special sciences will thus be fused by these interests and problems into an organic whole, and not remain a composite of fragments taken from the divisions of specialized science.

(*b*) The problem if properly chosen, developed, and carried out, will enable the child to gain a fund of experience and knowledge which can be stated in terms of specialized science, and so the adequacy and completeness of the course can be estimated.

(*c*) The problem basis of organization will by its very nature prevent specialization. Few problems will be found which lie wholly inside the limits of a single specialized science.

V.

The natural interests of children in the elementary school call for the study of plant life, animal life, climate, foods and food supply, rocks and the soil, earth forms, and of simple machines and mechanical forces. Many of the problems involved are geographical, or have geographical causal relations. The work will gain in continuity, effectiveness, and coherence, if these relations are emphasized.

(*a*) The organization of a comprehensive course in science, on the basis of large projects with subordinate problems, experiments, and the like, requires the inclusion of geography as an integral part of the course of study, and makes possible problems of a more varied character and of wider scope. It also makes for a simpler and more flexible school program.

VI.

The science course shall be continuous throughout the eight years of the elementary school, and furnish a proper basis and background of experience for the high-school courses in specialized science.

(*a*) The problems of the pupil constantly require the study of science and the development of scientific methods of study in order to find their solution. For this reason, science study rightly belongs in every year of both the elementary and the high-school life of the child.*

VII.

The many connections and correlations which science work has with other subjects of study shall be indicated as fully as possible in presenting the course in Science.

(*a*) Science work demands accuracy of definition, the power to organize material, the ability to think logically and to express the thought in clear and concise statements. This training in habits of thought which underlies clear and exact expression should render more effective all the written and oral composition of the school, and is one of the most important services which science study makes to the education of the child.

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*To give such a course is at present not possible in our high school, on account of the lack of facilities, as explained in the article on *Science in the High School.*

(*b*) The work in science frequently requires the use of mathematics and so supplies real problems for its study.

(*c*) Much of the handwork in many grades grows directly out of the science problems and contributes vitally to their solution.

VIII.

In the elementary school hygiene and physiology shall be taught in connection with the gymnasium work and preferably by the gymnasium teacher. These subjects naturally contribute to each other—the work in the gymnasium offering opportunity to apply what has been learned in recitations in hygiene and physiology, and the latter serving to make the former more purposeful and intelligent.

(*a*) It is thought that these teachers will be able to connect matters of hygiene and physiology with the problems of exercise, muscular control, proper methods of eating, breathing, etc., so as to furnish real motive for this study.

(*b*) The segregated classes will admit of freer and more normal discussion of certain important problems connected with hygiene.

In the detailed outlines of the science course which follow, it is hoped that the reader will find the embodiment of the principles which have been set forth. While the problem basis of organization is shown throughout the work, it has seemed necessary to retain many topical headings and divisions, in order to show how the problems and questions of the pupil naturally classify into topics or units of study. This also tends to offset the objection most commonly made to problem or project teaching, that it fails to secure a proper grounding in the fundamental principles of science and results in a hodge-podge of unrelated facts and ideas.

In harmony with the second fundamental principle, the emphasis throughout has been placed on the experimental work as the chief means of securing that first-hand experience and the actual handling of materials which is the special contribution of science study to the education of the child. For this reason, such purely descriptive work as the picturesque side of geography, the study of peoples and customs, has been largely eliminated from the outline.

The outcome of the science work in the several grades as well as its relation to the work in mathematics, English, and handwork is indicated by the illustrations, by representative children's papers, recitations and morning exercises.